

## **REMARKS/ARGUMENTS**

### **Status of Claims**

Claims 1 and 7-13 are pending in the application with claims 1 and 9 being the only independent claims. Claims 2-6 have been canceled without prejudice or disclaimer. Independent claims 1 and 9 have been amended to recite "surface side of said circuit." Additional amendments have been made to the claims to conform to U.S. patent practice without narrowing any of the claims or any claim element contained therein.

No new matter has been added.

### **Overview of the Office Action**

Claims 1, 8, and 10 have been rejected under 35 U.S.C. §103(a) as being unpatentable over US 7,375,757 to Hoshino in view of US 2001/0055073 to Shinomiya further in view of US 6,512,176 to Yaguchi.

Claim 7 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Hoshino in view of Shinomiya and Yaguchi further in view of US 6,528,889 to Matsuhira.

Claims 9 and 12-13 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Hoshino in view of Shinomiya and Yaguchi further in view of US 2004/0061799 to Atarashi.

Claim 11 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Hoshino in view of Shinomiya and Yaguchi further in view of Atarashi and Matsuhira.

### **Summary of the Subject Matter Disclosed in the Specification**

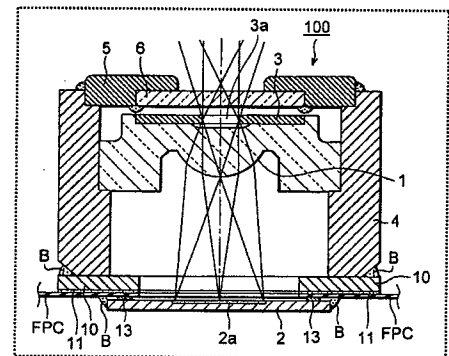
The following descriptive details are based on the specification. They are provided only for the convenience of the Examiner as part of the discussion presented herein, and are not intended to argue limitations which are unclaimed.

The present invention relates to an imaging unit mounted using a flip-chip mounting method in a compact portable terminal equipment such as, for example, a portable camera unit.

Typically, in a flip-chip mounted imaging unit, a thin FPC (Flexible Printed Circuit) board is provided between an imaging element and a lens focusing light onto the imaging element. An opening portion is formed in the thin FPC board allowing incident light to pass through and reach the imaging element. The opening portion however weakens the thin FPC board. To strengthen such thin FPC boards, reinforcing members, such stainless-steel plates, have been used to strengthening the imaging unit, or the FPC board.

However, the inventors have recognized that high thermal shock load can occur as a result of either internal circuitry operation of the semiconductor device or external environmental factors. For example, when a portable terminal equipment including an imaging element and a stainless-steel reinforcing plate is exposed to direct sunlight in a car, a high thermal shock load can occur to the portable terminal equipment. In these cases, the electrode pads of the imaging elements may peel off and thus damage the equipment.

The subject application provides a solution to the problem caused by a stainless-steel plate when being used to reinforce a thin FPC board in a flip-chip mounted imaging unit. In the imaging unit (100) of the subject application (see Fig. 2 reproduced herein), the reinforcing member (10) is made of a non-metallic material, such as ceramics and glass, having a linear expansion coefficient that is equal to or less than  $1 \times 10^{-5}$  (cm/cm/°C). The resulting imaging unit (100) has increased thermal shock resistant and durability (see paragraph [0028]).



## Summary of the Cited References

- Hoshino (US 7,375,757)

Hoshino discloses a flip-chip mounted imaging apparatus for use in a portable camera. In Hoshino, a substrate (10) is formed by a flexible wiring board (4) and a metal plate (13). The metal plate (13) is a stainless steel plate. See col. 3, ll. 38-40 of Hoshino.

- Shinomiya (US 2001/0055073)

Shinomiya teaches an imaging apparatus, in which an optical system 104-108 and an imaging element 109 are attached to a printed circuit rigid board 101. A printed circuit flexible board 201 is electrically connected to the printed circuit rigid board 101. The printed circuit rigid board 101 can be made of ceramics or glass epoxy. See, Fig. 13 and col. 2, ln. 4 to col. 3, ln. 11 of Shinimiya.

- Yaguchi (US 6,512,176)

Yaguchi discloses an insulating tape 2 made of a base material, such as polyimide resin or glass/epoxy resin. The linear expansion coefficient of the base material is about  $1 \times 10^{-5}$  (cm/cm/°C). See col. 1, ll. 57-65 of Yaguchi.

- Matsuhira (US 6,528,889)

Matsuhira discloses a circuit board that has an adhesion-reinforcing pattern 3 on an insulating substrate 1. An IC 4 having bumps S is joined through the underfill to the circuit board by thermocompression bonding using an Au-Sn joint technique. See col. 3, ll. 19-35 of Matsuhira.

- Atarashi (US 2004/0061799)

Atarashi discloses a flip-chip mounted imaging apparatus for use in a portable camera. In Atarashi, an FPC is used. A cutout is formed at the corner portion of an opening portion of the FPC. See paragraph [00149] of Atarashi.

## Patentability of the Claimed Invention

### Independent Claim 1

Independent claim 1 recites “an imaging element which is connected, by flip-chip mounting, to one surface side of said circuit board so as to cover at least part of the opening portion and expose an imaging area”, and “a reinforcing member which is made of a glass or ceramic material having a linear expansion coefficient of  $1 \times 10^{-5}$  (cm/cm/°C) or less and is attached to the other surface side of said circuit board to reinforce said circuit board.”

The combination of the cited references does not teach the above recited features of independent claim 1 because neither Shinomiya’s printed circuit rigid board 101 nor Yaguchi’s insulating tape 2 can be considered as “a reinforcing member” as recited in independent claim 1 for detailed reasons stated below.

The Office Action acknowledges that Hoshino does not teach a reinforcing member made of a glass or ceramic material (see page 3 of the Office Action). The Office Action however considers Shinomiya’s a printed circuit rigid board 101 being made of ceramics or glass epoxy to teach or suggest the claimed reinforcing member. However, the combination of Hoshino and Shinomiya fails to teach or suggest the recited “reinforcing member,” because the printed circuit board 101 of Shinomiya does not disclose the claimed features of the “reinforcing member”.

As applicants remarked above, Shinomiya teaches an imaging apparatus, in which the optical system 104-108 and the imaging element 109 are attached to the printed circuit rigid board 101 (see Fig. 13).

There is no teaching that the printed circuit rigid board 101 in Shinomiya is a reinforcing element. Rather, the printed circuit rigid board 101 is the circuit board to which the imaging element 109 is attached. The printed circuit rigid board 101 together with the imaging element 109 in Shinomiya is attached to one surface side of the printed circuit flexible board 201.

Therefore, the printed circuit rigid board 101 and the imaging elements in Shinomiya are not attached to the opposite side surfaces of the printed circuit flexible board 201 to reinforce the same. Accordingly, Shinomiya cannot be considered to teach or suggest “an imaging element which is connected, by flip-chip mounting, to one surface side of said circuit board” and “a reinforcing element which is made of a glass or ceramic material having a linear expansion coefficient of  $1 \times 10^{-5}$  (cm/cm/°C) or less and is attached to the other surface side of said circuit board to reinforce said circuit board”, as recited in independent claim 1.

Since Shinomiya’s printed circuit rigid board 101 cannot be considered as “a reinforcing element” of the printed circuit rigid board 101, the specific materials of ceramics or glass epoxy of such printed circuit rigid board 101 cannot be applied to modify Hoshino’s metal plate 13 to arrive at the reinforcing element recited in independent claim 1. Independent claim 1 is thus not obvious over the combination of Hoshino and Shinomiya for at least the above reasons.

The combination of Hoshino, Shinomiya and Yaguchi fails to teach that Hoshino and Shinomiya lack. The Office Action acknowledges that Hoshino and Shinomiya fail to teach a glass or ceramic material having a linear expansion coefficient of  $1 \times 10^{-5}$  (cm/cm/°C) or less (see page 3 of the Office Action). The Office Action however cites Yaguchi’s teaching of an insulating tape 2 made of a base material such as glass/epoxy resin and has a linear expansion coefficient of  $1 \times 10^{-5}$  (°C) and interprets such insulating tape 2 as the claimed reinforcing member. Applicants disagree because Yaguchi’s insulating tape 2 cannot be considered as “a reinforcing member” as recited in independent claim 1.

Yaguchi merely discloses that the insulating tape 2, which is used as an interposer and mounted to a lower side 1b of a semiconductor chip 1.

There is no teaching that the insulating tape 2 in Yaguchi is a reinforcing element of any component, much less a circuit board as is the reinforcing element recited in independent claim

1. Consequently, one skilled in the art will not be motivated to apply the teachings of Yaguchi's insulating tape 2 to modify Hoshino's metal plate 13 to arrive at the reinforcing element recited in independent claim 1. Independent claim 1 is thus not obvious over the cited references for the above additional reasons.

In view of all the above, independent claim 1 patentably distinguishes over the cited references. Withdrawal of the rejection of independent claim 1 is respectfully requested.

#### Independent Claim 9

Similar to claim 1, independent claim 9 recites "a reinforcing member which is made of a glass or ceramic material having a linear expansion coefficient of  $1 \times 10^{-5}$  (cm/cm/°C) or less and is attached to the other surface side of said circuit board to reinforce said circuit board."

Atarashi is cited in the Office Action for the alleged teachings concerning cutout portions 15 and does not remedy the deficiencies of Hoshino, Shinomiya, and Yaguchi. Therefore, independent claim 9 is allowable for at least the same reasons that independent claim 1 is allowable.

#### Dependent Claims 7-8 and 10-13

Claims 7-8 and 10-13 depend, directly or indirectly, from allowable independent claim 1 or 9 and are there allowable therewith.

In addition, claims 7-8 and 11-13 include features which serve to even more clearly distinguish the claimed invention over the prior art of record.

#### **Conclusion**

Based on all of the above, the present application is now in proper condition for allowance. Prompt and favorable action to this effect and early passing of this application to issue are respectfully solicited.

Should the Examiner have any comments, questions, suggestions or objections, the Examiner is respectfully requested to telephone the undersigned in order to facilitate reaching a resolution of any outstanding issues.

Respectfully submitted,  
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